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AUTHOR Bishop, John
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ABSTRACT

Wage rates and earnings give misleading signals to public and private policymakers as to the benefits of certain kinds of education and training investments. These misleading signals result from the fact that (1) workers and employers prefer employment contracts that either do not recognize or only partially recognize differences in productivity among workers doing the same job and (2) important dimensions of education and training accomplishment are often not signaled to potential employers and therefore have limited influence on the allocation of workers to jobs. Consequently, there are significant productivity differentials between workers receiving the same pay for the same job, and some of these are related to educational and training achievements that are not efficiently signalled. In light of these findings, policymakers in the education and training sectors should learn to generate better signals of the learning that occurs in school or on the job on the assumption that if employers have access to information on the competency that job applicants have developed in school they will use it. The second response to the problem should be to restructure the system of rewards and recognition in high schools. (An appendix to this report describes the data collection measures and sample population on which the study's conclusions are based.) (MN)

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THE RECOGNITION AND REWARD OF EMPLOYEE PERFORMANCE: IMPLICATIONS FOR EDUCATION AND TRAINING POLICY

by

John Bishop

Associate Director: Research

The National Center for Research in Vocational Education
The Ohio State University
1960 Kenny Road
Columbus, Ohio

After August 1986

New York State School of Industrial and Labor Relations
Cornell University

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The thesis of this paper is that wage rates and earnings give misleading signals to public and private decisionmakers regarding the social benefits of certain kinds of education and training (E&T) investments. The misleading signals are a result of the fact that (1) workers and employers prefer employment contracts which either do not recognize or only partially recognize differences in productivity among workers doing the same job and (2) important dimensions of E&T accomplishment--the skill, knowledge and competencies actually developed--are often not signaled to potential employers and therefore have limited influence on the allocation of workers to jobs. The result is that there are significant productivity differentials between workers who receive the same pay for the same job and some of these productivity differentials are related to dimensions of E&T accomplishment that are not efficiently signalled. Another consequence is that the social return to improvements in the quality of schooling and on-the-job training are considerably greater than private rates of return.

1.0 The Puzzle: Why Are Rewards for Academic Achievement in High School So Small?

According to the National Commission on Excellence in Education:

> Knowledge, learning, information, and skilled intelligence are the new raw materials of international commerce and are today spreading throughout the world as vigorously as miracle drugs, synthetic fertilizers, and blue jeans did earlier. If only to keep and improve on the slim competitive edge we still retain in world markets, we must dedicate ourselves to the reform of our educational system for the benefit of all-old and young alike, affluent and poor, majority and minority. Learning is the indispensable investment required for success in the "information age" we are entering. (p. 7).

Behind their call for higher standards and greater emphasis on academic subjects is the assumption that most jobs require (or soon will require) significant competency in communication, math and reasoning. To what extent does evidence from the labor market support this claim?

Are the workers who have the competencies listed above getting higher wages? To some degree yes. Academic achievement is associated with selecting or being selected for higher wage professional and managerial occupations and in these occupations those with the greatest academic achievement tend to be

the most successful. In blue collar and clerical occupations, however, academic achievement (as measured by tests and GPA) has almost no effect on wage rates and only a modest effect on the likelihood of being employed. Taubman and Wales's (1974) analysis of NBER-Thorndike's data, for instance, found that a one standard deviation test score differential (the standard deviation of math and verbal SAT tests is 110 points), raised earnings of clerical and blue collar workers only 1.3 percent for those is their early 30's and by 1.9 percent for those in their middle 40's.

In High School and Beyond follow-up data, correlations between wage rates and indicators of academic achievement of high school graduates who did not go to college are negative for unskilled and semi-skilled blue collar workers and for male clerical and retail sales workers. Only for female clerical and retail sales workers are the correlations positive but the implied effect of academic achievement on wage rates is small. The finding that academic achievement in high school does not have significant positive impacts on the wage rates of young people with 12 years of schooling is quite robust to changes in specification and sample. The basic result is unaffected (1) by adding controls for family background, curriculum and work during high school (2) by adding or subtracting current full time students from the sample and (3) by broadening the sample to include jobs in craft, professional, managerial and non retail sales occupations. Other data sets--Project Talent, Class of 1972 and NLS--yield similar results (zero or negative impacts on wage rates and positive impacts on employment) for the years immediately after high school. The result is also not affected by structural estimation which corrects for the selected nature of the sample--the tendency of the most able go to college. In Willis and Rosen's structural earnings model for high school graduates in NDER/Thorndike data, a one standard deviation increase in both the math and verbal tests lowered the beginning wage rate by 4.8 percent and increased earnings of 45 year olds by 6 percent. The impact of academic achievement on the wage rates and earnings increases with age and reaches a peak of 5 to 8 percent per standard deviation of academic achievement when the individual is over 35 years of age (Bishop 1985). What could explain such results?

One possibility is that those who did well in high school have selected jobs offering a great deal of general on-the-job training and that they are paying for this extra training by accepting a temporarily lower wage. This

hypotheses was examined by analyzing High School and Beyond data on the receipt of on-the-job training. Occasionally, academic achievement had a positive effect on the probability of receiving OJT but the effects were small and certainly not strong enough to cause the phenomenon cited above (Bishop and Stevens, 1986).

These results imply that the private payoff for academic achievement in high school is very small for those planning careers in clerical and blue collar occupations. At the end of high school, a one standard deviation academic achievement differential is equal to 3 or 4 grade level equivalents. Achievements gains of this magnitude are not easy to accomplish. If the student doesn't aspire to college or a professional or managerial job, the financial payoff is apparently, delayed for many years and reaches a maximum of only 5 to 8 percent of earnings. Under these circumstances, we should not be surprised that students who do not aspire to college often put only a minimum amount of time and energy into their academic studies.

Does this imply that for nearly half of all youth (those planning not to attend college) that the social returns to improved academic achievement are equally small? The answer would have to be yes if we make the assumption that is conventional in these calculations that the wage is equal to the worker's marginal product. If, however, we assume that wage rates approximate expected marginal products (not actual marginal products) and that employers are not aware of the worker's academic accomplishments when hiring and do not fully adjust wages to reflect actual productivity after hiring, there is no such presumption.

Assume that an E&T experience generates two outcomes: one observable, a credential (S) and the other unobserved by employers, knowledge (K). Assume further that the true relationship between productivity (P) and the outputs of the educational system S and K is

(1) $P = a_0 + aK + u$

Wages are set before work begins and structured to be equal to the worker's expected productivity. But lacking information on K, employers use regressions of P on S from past years to construct a compensation schedule that is keyed to schooling. Knowledge is related to S by $K = g_0 + gS + V$ so the compensation schedule is

(2) $W = ao + ag_o + agS$

Now enter an analyst whose assignment is to uncover the true nature of the relationship between education and productivity. The structural impact of knowledge is of special interest because the schools are planning to strengthen the curriculum. The lucky analyst finds a data set containing all three key variables, wages, credentials and knowledge and estimates the following regression:

(3) $W = c + aK + bS$

and obtains the following result a = 0 and b = ag. These results correctly characterize the private payoffs to the two dimensions of schooling.

But making the standard assumption that W≡P, the analyst also concludes that productivity depends on credentials rather than knowledge. He would be wrong, of course, but how can that be proved? What kind of evidence can establish that this very standard way of addressing the problem is yielding the wrong answer?

The best way to address the problem is to obtain and analyze dat on productivity. Direct measures of productivity are seldom comparable across firms or jobs so analyses would need to compare different occupants of the same job. A useful approach is to estimate models of the discrepancy between the individual's productivity and his or her wage, P-W.

(4) $P - W = \mu_o + \mu K + \emptyset S$

Estimating this equation in data generated by the true model would yield the following estimates:

$\mu = a$ and $\emptyset = -ag$

The true impact of K and S on productivity can be obtained by adding the relationship predicting the productivity wage discrepancy (equation 4) to the wage equation (3) estimated in the full population of jobs. The industrial psychology literature provides a great deal of useful evidence on equation 4--the correlates of relative productivity in samples of workers doing the same job and paid the same wage. Section 2 uses this evidence to demonstrate that productivity differentials associated with higher scores on tests of basic

communication skills and reasoning ability are considerably greater than the corresponding wage differentials.

The second kind of evidence that bears on the validity of the wage equals marginal product assumption (W≡P) is descriptions of the information environment of the hiring decision maker. Section 3 describes the types of information that employers have available when hiring workers for clerical, retail sales and blue collar jobs and demonstrates that they generally do not have the kinds of information--aptitude test or high school transcripts--that would enable them to make a reliable assessment of the worker's basic communication skills and reasoning ability.

Even where employers are unable to accurately predict productivity prior to hiring, they can revise their decisions later by firing the incompetent and giving merit increases and promotions to outstanding performers. Consequently, evidence on the degree to which realized productivity influences wage increases, dismissal decisions and promotions is crucial to an assessment of the validity of the wage equals marginal product assumption. Sections 4, 5 and 6 of the paper present an analysis of data from the 1982 NCRVE employer survey which addresses these issues. The final section of the paper discusses some of the implications of the paper's findings for education and training policies.

2.0 The Impact of Academic Achievement on Relative Productivity

Although for those who do not go to college the economic benefits of greater academic achievement are quite modest and do not appear until long after graduation, the benefits to the employer (and, therefore, to national production) are immediately apparent in higher productivity.

Over the last 80 years, industrial psychologists have conducted hundreds of studies, involving hundreds of thousands of workers, on the relationship between productivity in particular jobs and various predictors of that productivity. This enormous body of research has recently been reviewed and aggregated by Hunter and Hunter (1984) and Reilly and Chao (1983) and others. Using supervisor rating as the criterion, the mean validity (correlation between predictor and criterion adjusted for the unreliability of the criterion) is .54 for work sample tests, .49 for peer ratings and behavioral consistency experience ratings, .48 for job knowledge tests and .43 for assessment center evaluations (Hunter and Hunter 1984). For predictors used for entry-level jobs for which training will occur after hiring, the validities are .53 for composites of aptitude test, .44 for a job try-out, .37 for biographical inventories, .26 for reference checks, .18 for experience, .14 for the interview, .13 for training and experience ratings, .11 for grade point averages, .10 for years of schooling, .10 for interest inventories, and -.01 for age.

The job incumbants used to calculate these validity estimates have been through two different selection processes--first hiring and then retention--so these validity numbers are not estimates of population validities. Population validities will be higher in varying degrees. For our purposes, however, validity estimates based on samples of job incumbants are what is required. They characterize how the conditional expectation of relative productivity varies with a worker's characteristics in a sample of job incumbants. This problem is referred to as restriction of range in the industrial psychology literature. Since wage rates varied minimally in these samples (expect for seniority differentials), they also roughly characterize how the conditional expectation of P-W varies with each worker characteristic in a sample of job incumbants (i.e., equation 4).

Direct measures of knowledge--aptitude tests and job knowledge--have very large associations with reported productivity. This occurs regardless of

whether productivity is measured directly or by supervisory ratings. The associations are much larger than the comparable associations for grade point averages and years of schooling.[1] This contrast might be due to different population validities or it might be due to differential restriction of range--i.e., a tendancy to select job applicants on the basis of credentials rather than test scores.

Aptitude tests are designed to measure a variety of abilities. Our discussion categorizes them into 4 groups.

- General mental/academic ability--General mental/academic ability tests (such as the Scholastic Aptitude Test, broad scale achievement tests and the verbal and quantitative components of the GATB and ASVAB) focus on verbal, quantitative, and reasoning abilities. Thus, they test the competencies that are the prime objectives of schooling. [School attendance has been shown to improve performance on these tests (Lorge 1945). Improvements in education were probably responsible for the increase between World War I and World War II of one standard deviation (the equivalent of 110 SAT points) in the average test scores of army draftees on tests of this nature.]

- Spatial/Mechanical Ability--This includes the ability to perceive spatial patterns, manipulate or transform the image of spatial patterns into other arrangements and speed in exploring visually a complicated spatial field (such as tracing a path through a maze). Mechanical ability includes knowledge of machines and electricity and the ability to diagnose what is happening in mechanical drawings.

- General perceptual speed--General perceptual speed includes the ability to perceive detail quickly, to identify patterns, to visualize objects, and to perform other tasks that rely on speed or accuracy in picking out one element from a mass of apparently undifferentiated elements.

- Psychomotor ability--Psychomotor tests measure the speed of physically manipulating objects. An example is a dotting test, which requires the test taker to place a single dot within each of a series of very small circles.

Table 1 presents correlations between the three categories of aptitude tests and job performance for a variety of specific occupations. What is immediately apparent is that the tests that are the best predictors of job performance in most white collar and skilled blue collar occupations are the

[1]The validity estimate for years of schooling is small but positive. This refutes Ivar Berg's (1971) claim that in most jobs extra schooling is associated with lower productivity.

tests that measure abilities taught in school--the general mental ability tests. Note that the ability of tests measuring the output of schools

TABLE 1

VALIDITY OF ALTERNATIVE PREDICTORS OF ON-THE-JOB PERFORMANCE BY OCCUPATION

	Aptitude Test				
	General Mental Ability	Spatial and Mechanical Ability	General Perceptual Speed	Psychomotor Ability	Proportion of High School Graduates in Occupation
Managers	.40	.31	.32	.18	.08
Clerical	.38	.23	.39	.22	.28
Higher level sales	.45	.27	.31	.22	.03
Protective services	.30	.24	.28	.19	.02
Services	.36	.18	.13	.20	.04
Foreman	.35	.30	.36	.20	.02
Skilled craft	.34	.31	.32	.26	.13
Industrial (semiskilled)	.27	.27	.27	.30	.13
Vehicle operators	.22	.27	.23	.34	.04
Sales clerks	-.04	.19	-.03	.12	.08

Note: Derived from Ghiselli (1973) by correcting the raw correlations reported in his tables for the unreliability of the criterion (A conservative estimate of .55 for the reliabiltiy of the criterion means that the correlations are divided by .74). Hunter and Hunter (1984) provide an analogous table that corrects for restriction of range as well. This paper is investigating relationships within the selected sample not population relationships so correction for restriction of range would not be appropriate. Not covered by the table are professional and technical workers who account for 7 percent of high school graduates and laborers, janitors and household workers who account for 8 percent.

to predict job performance is not limited to jobs normally filled by college graduates but extends to clerical, skilled blue collar and service jobs in which people with 12 years of schooling predominate.

How large is the percentage increase in productivity that results from a given test score differential? This will depend on how much variation in productivity there is across workers. A recent review (Schmidt and Hunter 1983) of studies that contained direct measures of output for different workers

in the same job at the same firm found that the coefficient of variation of worker productivity varies a great deal from job to job but has a mean of approximately 20 percent when the job is not paid on a piece rate basis. Since there are fixed costs to employing an individual (facilities, equipment, light, heat, and overhead functions such as hiring and payrolling), the coefficient of variation of net marginal product is likely to be even greater (Klein, Spady and Weiss 1983; Schmidt and Hunter 1983; Boudreau 1983). If we make the very conservative assumption that the coefficient of variation of marginal productivity for clerical jobs is 20 percent, the .38 validity of general mental ability implies that a one standard deviation test score differential is associated with an 8 percent productivity differential (.38 x 20%). For other occupations these same assumptions about the coefficient of variation produce a predicted productivity differential of 7 percent in skilled trades and crafts and in service jobs, and 5 percent in semi-skilled factory jobs. Except in the higher level sales occupation, wage rates were uncorrelated with test scores in the data sets used to estimate these validities; consequently, these numbers are estimates of the impact of knowledge on the productivity wage differential. They are also estimates of the magnitude of an information externality which diminishes the incentive to learn and thus the time and energy devoted to study. Apparently employers receive much of the benefit when a non-college-bound student works hard in school and improves his or her academic achievements.[2] The youth is more likely to find a job, but not one with an appreciably higher wage. The rest of the paper examines reasons for the discrepancy.

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[2]The industrial psychology literature just reviewed establishes that those who do better on academic ability and achievement tests are more productive on the job. The educational literature establishes that school attendance, curriculum geater time on task, and commitment to learning can improve performance on tests like these (see also Hotchkiss 1984 and chapter 3). In this section it is assumed that these two findings, in turn, imply that greater efforts to develop the skills measured by these tests will make the individual more productive. Some have argued, however, that the ability to learn quickly (the underlying trait that is probably responsible for strong correlations between SAT-type test and job performance) is inherited or at least fixed by the time a child enters school (Jensen 1969). In this view, tests of basic skills (vocabulary, reading, math, etc.) are good measures of learning ability, because everyone receives roughly equivalent exposure and instruction in the material, so differences in knowledge at the end of high school primarily reflect differences in an unalterable IQ. If Sanskrit had been taught to everyone in school, a test of Sanskrit would have done just as well. A recent study (Boissiere, Knight, and Sabot, 1985) of the determinants of earnings in Kenya suggests that it is literacy not inherited IQ that determines earnings. Measures of literacy

3. The Absence of Information on the Academic Accomplishments of Job Applicants with 12 or Fewer Years of Schooling

Employers are presumably competing for better workers. Why doesn't competition result in much higher wages for those who achieve in high school or for those who do well on general mental ability tests? One cause appears to be the lack of objective information available to employers on applicant accomplishments, skills, and productivity.

The Low Validity of Interviews. Employers in our survey spent an average of ten hours screening, interviewing, and reference checking to fill each position. Most of that time was devoted to interviewing. Studies of hiring have found that interview performance is crucial to getting a job offer.

A considerable body of research exits that shows the selection interview to be low in reliability and validity. Mayfield (1964) conducted a thorough review of the literature and came to the following conclusions:

> General suitability rating based on an unstructured interview with no prior information provided has extremely low interrater reliability, especially in an employment situation . . . . In other words, the interview as normally conducted in a selection situation is of little value (p. 249).
>
> If the interviewer has valid test information available, his [or her] prediction based on the interview plus test information are usually no better and frequently less valid than the predictions based on the test alone (p 251).

In their review of the literature, Dunnette and Bass (1963) stated:

> The personnel interview continues to be the most widely-used method for selecting employees, despite the fact that it is a costly, inefficient, and usually invalid procedure. It is often used to the exclusion of far more thoroughly research and validated procedures (p. 117).

The recent review of the literature by Arvey and Campion (1982) concludes with a discussion "of why use of the interview persists in view of the evidence of its relatively low validity, reliability, and its susceptibility to bias and

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and communication ability were strongly related to wages while measures of nonverbal IQ (Raven's Progressive Matrices) were not. The view taken in this chapter is that inherited learning ability accounts for only a small part of the relationship between tests of basic skills and job performance (Goldberger 1979; Kamin 1974). Instead, the relationship arises primarily because the tests are measuring (a) an ability to communicate--read, write, listen, and speak--that is essential to learning new tasks, and (b) skills and knowledge that are the foundation upon which job specific knowledge is built. A thorough coverage of this controversy is beyond the scope of this paper.

distortion." (p.314). The selection interview is an ineffective device for selecting the best job candidate.

Little Use of High School Transcripts

Most job applications request only information about years of schooling, whether a diploma or certificate was obtained, and area of specialization, if any. These attributes play an important part in employer decisions. Probably because of unreliable reporting, most applications do not ask the individual to report grade point averages.

It is very unusual for employers to use high school transcripts to select which job applicants to interview and only a minority even request transcripts during the selection process (Malizio and Whitney 1984). One reason why most employers fail to use high school transcripts to select workers is that the transcript is not as informative as it might be. Information on deportment (e.g., absenteeism, tardiness) is generally absent. Course titles do not reveal what has been learned and grading standards differ from course to course and from school to school. Despite these problems, when the information is included on their job application high grade point averages have a very large positive impact on employer ratings of job applicants (Hollenbeck and Smith 1984). High school transcripts are seldom used for selecting workers because many high schools are not responding to requests for transcripts and when they do respond the transcript generally arrives after the hiring decision is made.

If a student or graduate has given written permission for a transcript to be sent to an employer, the Buckley amendment obligates the school to respond. Many high schools are not, however, responding to such requests. The experience of Nationwide Insurance, one of Columbus's most respected employers, is probably representative of what happens in most communities. Permission to obtain high school records is obtained from all young people who interview for a job. Nationwide sent over 1,200 such signed requests to high schools in 1982 and received only 93 responses. Each request asked for information on grade point average, class rank, tardiness, absences, and courses in wich the student earned a B or better. When a response was received, only the GPA was provided in most cases. Fewer than 20 responses gave all the information requested. Employers reported that colleges were much more responsive to transcript requests than high schools. High schools have apparently designed their systems

regarding transcript requests to be responsive to the needs of their college attending graduates and colleges rather than to the needs of their job seeking graduates and the employers these graduates have contacted.

An additional barrier to the use of high school transcripts in selecting new employees is that when high schools do respond, it requires a significant amount of time. For Nationwide Insurance the response took more than 2 weeks. Given this time lag, if employers required transcripts prior to making hiring selections, a job offer could not be made until approximately one month after an application had been received. Most jobs are filled much more rapidly. The 1982 NCRVE employer survey of employers found that 83.5 percent of all jobs were filled in less than a month, and 65 percent were filled in less than 2 weeks. Employers fill lower level jobs quickly because of the following:

- Employers generally have little or no notice that an employee is leaving. In our survey employers reported that they had some advance notice only 52 percent of the time. They were given notice 2 weeks to 1 month in advance only 12 percent of the time, and notice of 1 month or more only 11 percent of the time.
- Leaving a position unfilled can disrupt the office or factory routine and cause deadlines to be missed or sales to be lost.
- Job candidates often have an urgent need to work. They quite reasonably prefer to apply at firms that promise to make quick decisions.

The high cost of delaying hiring selections means that even firms that routinely request high school transcripts often make job offers prior to the arrival of transcripts.

Lack of Referrals

Informal referrals of specific students to local employers can be very effective in helping students obtain jobs. Typically, only the vocational students receive this service from their high schools, yet referral is probably the most important mechanism whereby schools influence which students get which jobs. When referral is an informal part of a relationship of trust between teacher or principal and employer, the system works well. However, various federal and state laws and administrative regulations have made it illegal for school staff to share certain kinds of information with potential employers without the student's written permission. As a result, employers who once depended on such referrals feel they no longer trust school personnel to warn

them if, for example, a particular job candidate is considered to be a "troublemaker" at school. These legal hazards have also contributed to making the referral process more formalized and centralized, which in turn, appears to reduce the effectiveness of placement efforts. McKinney et al. (1982) found that use of a placement office (which tends to take responsibility for placement away from the individual vocational teacher) reduces a school's rate of placing vocational graduates in jobs relevant to their training.

Aptitude Tests

Aptitude tests are used by some employers but their use has been circumscribed by employer ignorance of the usefulness of such tests in predicting job performance and the Equal Employment Oppotunity Commissions (EEOC) Guidelines on Employment Testing Procedures. The guidelines prohibited the use of a test on which minorities or women scored below white males unless the employer proves to EEOC's satisfaction the following: that the particular test was a valid predictor of performance on jobs at that particular firm. Each firm proposing to use a test had to do its own validity study separately on blacks and whites (29C.F.R.S607.5(b); Wigdor, 1982). Small firms do not have enough employees in particular job classificaitons to do such a study and cannot in any case afford their great cost. Only recently have a few courts started to accept industry-wide validation studies as evidence of a test's validity for a particular firm's jobs. The firm also had to prove that no other test or selection method was available that was equally valid but had less adverse impact. Since there are hundreds, possibly thousands of potential selection methods with less adverse impact, the firm was potentially obligated to prove that all of these alternatives were less valid predictors of job performance than the one selected. These regulations have been a major deterrent to the use of aptitude tests.

4. The Effect of Relative Productivity on Relative Wage Rates

The widespread use of formal performance appraisal implies that employers believe they can rate the productivity of their employees. If these ratings are reasonably accurate and are used to award merit increases and to make layoff or promotion decision, the sorting that results will tend to drive relative wage rates to equality with relative productivity. The next 3 sections of the paper examine the extent to which this is occuring. Section 5 examines the effect of relative productivity on turnover and section 6 examines its impact on promotions. In this section we examine whether differentials in productivity (relative to one's co-workers) are fully or only partially incorporated into relative wage rates.

Adjusting relative wage rates to reflect relative productivity produces two kinds of benefits for the firm. First it serves as an incentive for greater effort. Secondly, it reduces the probability of losing the best performers to other firms and raises the probability that the least productive wokers will leave. On the other hand, information on a worker's effort and productivity are often costly to obtain, and the theory of implicit contracts implies that these information assymetries will often result in only partial adjustment of the wage to productivity. There are at least 6 reasons for this.

The first reason why the contracts that govern the employment relationship may specify only partial adjustment of relative wages to relative productivity is worker risk aversion. It is often the case that observed productivity is a function of unobservables--effort or a random state of nature such as the worker's ability or the territory, machine, or co-worker to which he or she is assigned. Setting up a compensation scheme which varies wages dollar for dollar with realized productivity establishes the correct incentives for effort but forces the worker to accept a great deal of risk. The worker's aversion to risk leads him or her to prefer contracts that are not conditioned so strongly on realized productivity. The optimal contract in such an environment will be a compromise between full and zero incorporation of realized productivity into the wage. Exactly where the compromise is struck depends upon the strength of worker risk aversion, the responsiveness of effort to reward, and the variance of the random element (Stiglitz 1974;

1975). If firms can monitor the worker's effort, worker risk aversion will induce firms to offer contracts in which pay is based primarily on effort rather than on realized output (Harris and Raviv 1979).[3] This further reduces the dependence of wages on realized productivity.

Second, productivity differentials between workers at a firm might reflect differences in skills that are specific to the firm or only known to the firm. If the worker is not able to translate high productivity at the current employer into a higher wage offer at another firm, the competitive pressure on the current employer to raise the individual's wage is reduced. Even if all productivity differentials within the firm reflect differences in generalized competence, it is very difficult in most jobs for other employers to measure these differentials accurately and thus base wage and job offers on them. No one is likely to tell a prospective employer the truth. Self-reports of productivity are probably treated with skepticism. The individual's employer has an incentive to speak very positively about the workers he wants to get rid of and negatively about the workers he wants to keep. Most employers are reluctant to talk about prior employees. Separating employees who have felt that they were unable to get a good job because they are getting a poor recommendation from a previous employer have successfully sued that employer. This has made most employers reluctant to talk about their past employees. In an interview, we conducted with the personnel director of Nationwide Insurance, we were told; "We warn our managers all the time. If someone

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3. Evidence that firms care a great deal more about productivity losses arising from lack of effort than they care about equivalent losses arising from ability or skill deficits is not hard to find. A recent survey (Miguel and Foulk, 1984) asked 150 supervisors to describe how they would handle various violations of job expectations. The respnse categories supplied to them were ignore, discuss if persists, discuss immediately, warning, suspend, and fire immediately. These response categories were assigned numerical values from zero for ignore to five for fire immediately. The typical reaction to a worker who "tries but is 15 percent less productive than other workers with the same training" (1.73) and to a worker who "seems not to be trying but is no less productive than other workers" (1.53) tended to be to discuss it with the worker either immediately or if it persists. A worker who "doesn't try and is 15 percent less productive than others with the same training" was typically in much more serious trouble. Their mean score was 3.07 implying that they would immediately be given a warning, and they would be fired if it persisted.

calls you on the phone and asks you about someone who has left the company, you refer them to personnel. You don't say word one to them. You could be put in the position where you are going to be in court some day."

A third reason that differences in relative productivity may not be reflected in wages is that the firm is recognizing the greater output in ways that are not as visible to those outside the company. In most jobs, the only indicator of a worker's relative productivity that is likely to influence another employer is the worker's job classification and relative wage rate.

Wage increases and promotions are often justified on the grounds that they will reduce the probability of losing that employee. But, they also transmit signals to other employers about the employee's productivity, and consequently, raise the wage the promoted employee is likely to be able to obtain elsewhere. This means that as an instrument for retaining the most productive employees, promotions and wage increases are partially self-defeating. Rewards for performance that are not visible to other potential employers such as praise, desirable job assignments, greater autonomy, being able to select subordinates, and opportunities for travel and vacations probably have larger effects on retention and morale than equivalently costly wage increases.

A variant on this explanation has been proposed by Frank (1984). He posits that a workers' satisfaction with a job (utility) is influenced by his/her relative status in the firm or among coworkers as well as the absolute level of the wage. If so, a merit increase or promotion generates two kinds of benefits for the worker: a somewhat higher wage and a movement up the firm's status hierarchy. The greater the perceived importance of relative status, the smaller are the wage increases necessary to motiveate workers to put out maximum effort.

The fourth explanation is the high cost of accurately measuring a particular worker's productivity. In most jobs, objective indicators of productivity simply do not exist. This is part of the reason why in November 1975, only 1.2 percent of the nation's workers were paid on a piece rate basis and only 1.9 percent on a pure commission basis (Flaim 1976). In most work environments, productivity-based wage setting would have to use subjective

evaluations by immediate supervisors. These supervisory assessments are known to contain measurement error. Meta-analyses of supervisor rating studies have found that 0.6 is the upper bound on the coorelation between the ratings given the same worker by two different raters (King, Hunter, and Schmidt 1980). Wage setting in such an environment would take into account the measurement error, and the elasticity of the wage rate with respect to measured productivity will be less than one (see Hashimoto and Yu 1980).

Top managements of large organizations sometimes fear that some line supervisors may abuse the power this kind of wage setting gives them. Supervisors may also misperceive the criteria they are supposed to use. If a union represents the workers, the ability and inclination of management to adjust wages to productivity is reduced even further. In small owner-managed firms unions are not as much of a threat and the owner makes the decision about the wage to offer. The threat of unionization and the difficulty of ensuring that supervisors will carry out instructions correctly is greatest in large organizations so one would expect a weaker connection between relative productivity and relative wage rates in large establishments than in small establishments.

A fifth reason for expecting the immediate response of relative wage rates to relative productivity to be small is that extra compensation for outstanding performance is often deferred. A merit increase in year 1 raises wage rates in later years even if the outstanding performance of year one is not repeated. Consequently for workers anticipating long tenure, the present value of a merit increase is considerably greater than its first year impact. If anticipated tenure is short deferred rewards for outstanding performance will not be attractive to a worker. Consequently, firms with high rates of turnover might be expected to offer larger immediate rewards for outstanding performance.

The sixth reason for an elasticity below one is that productivity is not perfectly correlated over time. The consistency of worker performance is greatest when conditions of work are stable. For adjacent weeks coorelations of output rate for routine tasks run as high as 0.96 (Tiffin 1942; Rambo, Chomiak; and Price 1983) and as low as 0.68 (Rothe 1978) when pay is based on an incentive system. The average correlation for 8 different studies was

0.86. Most jobs are not paid on an incentive, however, and conditions of work are often changing. In more typical environments where pay is not based on an incentive and the work environment is changing, correlations for adjacent weeks ranged from 0.48 (Rothe and Nye 1961) to 0.69 (Rothe 1947), and over 4 studies averaged 0.585. Whether correlations for quarterly or yearly averages would be higher or lower than this can be debated. Using longer time intervals should increase the consistency of performance, but the longer time intervals between measurement will reduce the coorelation (Rambo, Chomiak; and Price 1983). If employers try to set wage rates equal to next periods expected productivity, the lack of performance consistency will result in an elasticity of future wage rates with respect to current productivity that is less than one.

The econometric framework for examining the extent to which wages reflect actual differences in productivity will now be presented. We assume that the "i"th workers' wage relative to the mean for the job is described by the following equation:

$$(5)\quad W_{ij} - \bar{W}_j = b_1(P_{ij} - \bar{P}_j) + b_2(T_{ij} - \bar{T}_j) + B(X_{ij} - \bar{X}_j) + u_{ij}$$

where

$W_{ij} - \bar{W}_j$ = the deviation of the individual wage from the mean

$P_{ij} - \bar{P}_j$ = the deviation of the individual's productivity from the mean.

$T_{ij} - \bar{T}_j$ = the difference between the training required by the individual and that required by the typical worker.

$X_{ij} - \bar{X}_j$ = a vector of differences in tenure, credentials and background characteristics between the individual and the mean for occupants of the job.

u_{ij} = individual specific error term.

Data are not available on the means ($\bar{W}$, $\bar{P}$, $\bar{T}$ and $\bar{X}$) so equation 5 cannot be estimated. For many firms, however, there is data on two workers

doing the same job so the following equation for the difference between the wage rates of person 1 and 2 can be estimated:

$$(6)\quad W_{1j}-W_{2j} = b_1(P_{1j}-P_{2j}) + b_2(T_{1j}-T_{2j}) + B(X_{1j}-X_{2j}) + u_{1j}-u_{2j}$$

If there is a feedback from realized productivity and training to wage rates, we expect the coefficients on productivity and training to be significantly different from zero. Specifically, we expect the coefficient for productivity to be positive and the coefficient for training to be negative. On the other hand, if the firms do not adjust their wage rate to observed productivity and training investment, the coefficients on these variables will be zero.

Two equations for wage rates, one for starting wages and the other for latest wages, were estimated. The appendix to the paper describes the data set employed in the analysis and the method by which training investment and reported productivity were measured. The results are presented in table 2.

The starting wage is generally set before the new hire starts work, so one would not expect it to have a very strong relationship with realized productivity. This expectation is confirmed by the small size and insignificant coefficients on the three measures of worker productivity. Employers do seem to be able to anticipate when a new hire will require extra training, however, and to offer lower wage rates to new hires who require the extra training. The magnitude of this impact is not particularly large. An increase in training during the first 3 months by the equivalent of one fifth of the new employee's potential productivity reduces the new hire's starting wage by only 2 percent. The small size of this response suggests either that most of the training in the first 3 months is specific to the firm or that the employer has difficulty anticipating how much additional training an inexperienced worker is going to require.

Worker characteristics generally have larger impacts on starting wage rates than on current wage rates. Holding realized productivity and total experience constant, 5 years of relevant work experience raises wage rates by 6.8 percent at the start but by only 2.6 percent at the time of the interview. Being a referral from a union has an extremely large effect on starting wages

TABLE 2

IMPACT OF WORKER PRODUCTIVITY ON WAGE RATES

	Starting Wage		Latest Wage	
Training Time (100's of hrs.)	-.019*	(1.89)	-.022	(1.51)
Productivity				
2d week	.084	(1.37)	.045	(.51)
3d-12th week	.020	(.26)	-.000	(.00)
At interview or separation	-.011	(.26)	.215***	(3.63)
Relevant Experience	.0155***	(4.34)	.0059	(1.17)
Relevant Experience Sq. (divided by 100)	-.039***	(4.54)	-.016	(1.38)
Total Experience	.0079***	(4.04)	.0072***	(2.64)
Total Experience Sq. (divided by 100)	-.017***	(3.28)	-.0135*	(1.79)
Years of Schooling	.012***	(3.08)	.012**	(2.16)
Relevant Vocational Education	.039***	(3.21)	.030*	(1.77)
Private Vocational Education	.008	(.28)	.023	(.62)
Female	-.040*	(1.90)	-.029	(.98)
Known to Be TJTC Eligible	-.062	(1.64)	-.165***	(3.10)
Union Referral	.426***	(4.69)	.115	(.90)
Number of Observations	456		456	
R Squared	.353		.306	

NOTE: This table is based on fixed effects models that compares two new hires for the same job at the same firm. Other variables in the model were whether the job was temporary, whether the individual was a student, hours worked per week, whether referred by a relative, and whether subsidized by a program other than TJTC. The model for latest wage also contained tenure and tenure squared. The model for starting wage contained date of hire and the date of hire squared.

* significant at the 10% level (two-sided)
** significant at the 5% level (two-sided)
*** significant at the 1% level (two-sided)

but a much smaller effect on current wages. This pattern of results--large impacts of worker characteristics and small impacts of realized productivity--confirms our expectation that the main determinants of the starting wage are worker characteristics observable prior to the hiring decision.

Latest wages are clearly a function of both worker characteristics and actual productivity. Total experience, years of schooling, and relevant vocational education all had statistically significant impacts on relative wage rates. Reported productivity at the time of interview or separation also had large statistically significant effects on wage rates. The elasticity of the wage rate with respect to reported productivity is 0.17 (0.8 x 0.215). The fact that this value is significantly below 1 implies that wages for workers who have been at a firm for about a year only partially reflect person-to-person variations in reported productivity on the job. The person who provided these productivity reports was, in most cases, the owner-manager of a small establishment (70 percent had fewer than 50 employees) and was thus quite frequently the person who decides on the wage offer for each individual. The regression is therefore capturing the relationship between the productivity of individual workers as perceived by the person setting wages and the wage rate that is offered and agreed to.

What do these results imply about the elasticity of relative wage rates with respect to true productivity? If relative wage rates are set on the basis of perceived relative prouductivity and not true relative productivity, and the elasticity of perceived relative productivity with respect to true relative productivity is less then one, then .17 is an upper bound on the magnitude of the within job elasticity of wage rate with respect to true productivity. This finding helps explain why studies that have absolute measures of worker productivity typically find that coefficients of variation productivity greatly exceed the coefficient of variation of wage rates. Bobko, Karren, and Parkington's (1983) study of 92 insurance counselors found, for instance, that coefficients of variation were 42 percent for the sales of these counselors but only 14.6 percent for their earnings.

The conclusion that relative wage rates at interview or separation depend on realized productivity as well as worker characteristics is subject to chal-

lenge, however, if employers set wage rates on the basis of worker characteristics such as recommendations from previous employers and aptitude test scores that are not available to the researcher. If such information is available to the employer and it has a continuing effect on wages even after the new hire has been at the firm for a year, the productivity measures will tend to pick up the effects of these omitted worker characteristics and the coefficients on current and lagged productivity will have a positive bias. We examined the presence of omitted variables in wage equations by jointly estimating the starting and latest wage equations using seemingly an unrelated regression technique. Evidence that some of the determinants of relative wage rates are not included in our models is provided by the fact that there is a positive correlation of 0.3 between the errors of the 2 equations. Any possible bias produced by an omitted characteristic, however, seems to be very small. For the latest wage, it is only the contemporaneously measured productivity variable that has a large positive effect on the wage, and actual productivity in the first 2 weeks and the next 10 weeks show no significant impact. Also, in the starting wage model, it is actual productivity in the first 2 weeks that has the largest positive effect and current productivity shows no significant effect. This pattern of coefficients suggests that (1) omitted worker characteristics are not a significant source of bias for the coefficients on the productivity variables in the model of the latest wage and (2) wages adapt quickly though not completely to the realized productivity of the new worker.

One would not expect all firms to be equally able or inclined to adjust relative wage rates to the realized relative productivity of workers. It was hypothesized earlier that large establishments and unionized firms would be less likely to base wage increases on supervisor opinions of a worker's productivity. This hypothesis was tested by entering interactions between current productivity on the one hand and size and unionization on the other into the models predicting a worker's current relative wage (see table 3). Both coefficients were negative as anticipated, and the coefficient on the interaction term for size and productivity was significantly negative. The elasticity of the wage with respect to productivity is 0.2 (i.e., 0.8 [0.198 + .052]) at non-union establishments with 17 employees. Though the coefficient

TABLE 3

IMPACT OF WORKER PRODUCTIVITY ON WAGE RATES:
INTERACTIONS WITH UNIONIZATION AND SIZE

	Starting Wage		Latest Wage	
Training Time (100's of hrs.)	-.020**	(2.01)	-.017	(1.17)
Productivity First 2 Weeks	.080*	(1.87)	.052	(.79)
Productivity (most recent)	--		.198***	(4.21)
Size Times Productivity	.019	(.73)	-.055*	(1.80)
Union Times Productivity	.179	(1.11)	-.138	(.62)
Union Referral	.382***	(4.08)	.120	(.94)
Hired a Relative	-.041*	(1.93)	-.037	(1.23)
Referral by a Relative	.024	(.41)	-.016	(.19)
Relevant Experience	.0154***	(4.31)	.0064	(1.29)
Relevant Experience Sq. (divided by 100)	-.038***	(4.49)	-.018	(1.48)
Total Experience	.0075***	(3.87)	.0077***	(2.80)
Total Experience Sq. (divided by 100)	-.017***	(3.13)	-.015**	(1.99)
Years of Schooling	.012***	(3.08)	.012**	(2.13)
Relevant Vocational Education	.039***	(3.17)	.026	(1.53)
Private Vocational Education	.004	(.16)	.024	(.63)
Female	-.039*	(1.84)	-.024	(.81)
Known to be TJTC Eligible	-.071*	(1.87)	-.165***	(3.10)
Received JTPA Subsidy	.007	(.19)	-.002	(.03)

NOTE: This table is based on fixed effects models that compares two new hires for the same job at the same firm. Models were estimated using seemingly unrelated regression. Other variables in the model were whether the job was temporary, whether the individual was a student, and hours worked per week. The model for the latest wage also contained tenure and tenure squared. The model for starting wage contained date of hire and the date of hire squared. The weighted R square for the system was 0.332, and the coorelation between the residuals of the 2 equations was 0.39. In the starting wage model, size and unionization are interacted with productivity in the second week. In the latest wage model interactions are with most recent productivity.

* significant at the 10% level (two-sided)
** significant at the 5% level (two-sided)
*** significant at the 1% level (two-sided)

on the unionization interaction is not statistically significant, it's point estimate implies that a unionized firm of that size would have an wage elasticity with respect to productivity of 0.09. The results imply that the elasticity of the relative wage with respect to relative productivity will be 0.09 at a non-union establishment with 200 employees, -0.02 at a unionized establishment with 200 employees, and 0.02 at a nonunion establishment with 1,000 employees. Clearly the relative wage rates of different workers in the same job do not vary proportionately with their productivity. In medium-sized unionized establishments, and large non-union establishments, there does not seem to be any immediate response of relative wages to reported relative productivity. Such establishments are underrepresented in this data set, so the mean elasticity of .17 derived from this sample exaggerates the true average response of relative wage rates to reported relative productivity.

5. The Effect of Training and Productivity Growth on Turnover

What impact does the productivity of a worker and the training received by that worker have upon turnover? The findings in the previous section support a view that wage rates and other job rewards are in most cases tied to the job occupied and respond to the perceived competence of individual workers only incompletely. Another way employers may respond to productivity differentials between workers is by promoting the most productive and firing the least productive. Many employment contacts (both explicit and implicit) greatly limit the firm's flexibility in setting wage rates but offer it great flexibility in releasing unproductive new hires during a probationary period that may last as long as 6 months. Why do firms offer labor contracts in which they fire less-productive workers rather than offering them a lower wage? The contract literature has suggested a number of reasons why firms may choose to offer such contracts. As a worker gains tenure on the job, the specificity of the job match increases. Renegotiating wage rates after specific training is completed will be very costly because the gap between the threat points of each party can be quite large and the incentives for strategic behavior are strong (Hashimoto and Yu 1981).

A second reason for such contracts might be morale considerations. Retaining an unproductive worker who has been chastened by receiving a salary

cut or demotion may be bad for morale. The bitterness that such an event causes may result in grievances being filed against the company, efforts to organize the firm's employees, further declines in the worker's productivity, damage to the morale and cohesiveness of the work group, and sabotage (Akerlof 1982).

In this subsection, we examine the impact of differentials in realized productivity and differentials in training investment on the differentials in turnover of people occupying the same job. How responsive is turnover to such differentials? At which types of firms is turnover most responsive to productivity and training differentials? Have the firms that are unable to adjust wages to productivity differences compensated for this by being quicker to fire the workers who are less productive? Or, are the types of firms that adjust wages to productivity also more likely to fire the less-productive employees? These issues were addressed by studying a sample of workers who had been recruited for permanent jobs and who stayed at the firm at least 3 months. The effects of the firm's characteristics on the average level of turnover was partialed out by examining differences in subsequent turnover between pairs of workers who had the same job and met the selection criteria noted here. Limiting the sample to those who stayed at the firm at least 3 months means that we have one measure of training investment and two measures of reported productivity that are not contaminated by turnover events. The models therefore characterize the effect of the training provided in the first 3 months and the productivity achieved during that period on subsequent turnover.

Models were estimated predicting differences in the log of actual tenure and probabilities of voluntary and involuntary separations. The results of the analysis are presented in table 4. When measures of actual training and productivity were included in the models, almost none of the characteristics of the worker were statistically significant. The sole exception to this was that people recruited through newspaper ads were more likely to be fired and had shorter tenure, school referrals had lower dismissal rates, employer referrals had higher dismissal rates, and women had lower quit rates. By far the most powerful determinant of turnover is reported productivity during the

TABLE 4

IMPACT OF TRAINING AND PRODUCTIVITY ON TURNOVER
(within firm models)

Explanatory Variables	Log Tenure		Involuntary Separation		Quit	
Log Training Intensity	.123*	.123*	-.146***	-.140***	.029	.031
	(1.8)	(1.8)	(3.3)	(3.2)	(.5)	(.5)
Log Training Intensity Times Size	-.014		-.042		.015	
	(.3)		(1.4)		(.54)	
Productivity 2d Week	-.617**	-.605**	-.440**	-.400**	.110	.180
	(.3)	(2.1)	(1.4)	(2.2)	(.5)	(.8)
Productivity 3d-12th Week	2.400***	2.367***	-.674***	-.673***	-.490**	-.537**
	(8.4)	(8.3)	(3.7)	(3.7)	(2.1)	(2.3)
Productivity 3d-12th Week Times Size	-.398**	-.339***	-.186**	-.116	.211*	.210**
	(2.3)	(2.6)	(2.1)	(1.4)	(1.8)	(2.0)
Productivity 3d-12th Week Times Union	-.399	-.446	1.047**	1.146**	.600	.592
	(.5)	(.6)	(2.0)	(2.2)	(.9)	(.9)
Log Starting Wage	-.270		.101		-.086	
	(1.2)		(.7)		(.5)	
R Squared	.592	.588	.242	.226	.121	.114

NOTE: These models of differences between the tenure and turnover of two workers in the same job have the following control variables: dummies for referral source, relevant experience and total experience and their squares, log of potential tenure and its square, years of schooling, gender, relevent vocational education, private vocational education, known to be TJTC eligible when hired, subsidized by JTPA, hours worked per week, and working at the firm while part of a co-op program.

* significant at the 10% level (two-sided)
** significant at the 5% level (two-sided)
*** significant at the 1% level (two-sided)

3d-12th week of employment. When the productivity scale is defined over a range from 0 to 1, workers' productivity in the 3d-12th week has a mean of 0.65 and standard deviation of 0.14. A 1 standard deviation (0.14) rise in the productivity report raises expected tenure by 39 percent at a nonunion company with 19 employees. It lowers the probability of being fired by 9 percentage points and the probabilities of quitting by 7 percentage points. If productivity is 0.14 higher both initially and during week 3-12, expected tenure is 27 percent greater, the probability of being fired is 14 percentage points lower, and the probability of quitting is 4.5 percentage points lower. Less productive workers are more likely to quit, but it is in the probability of being fired or laid off where the really big differences show up.

The responses of turnover to a worker's productivity clearly depend upon the size of the firm and on whether it is unionized. A worker's productivity has a smaller effect on expected tenure at large unionized firms. A 1 standard deviation (0.14) increase in both productivity reports increases expected tenure by 27 percent at nonunion companies with 19 employees, by 13.5 percent at non-union companies with 200 employees, and by 6.7 percent at unionized companies with 200 employees. Size and unionization have very different effects on the two forms of turnover. Most probationary periods in union contracts are for 3 months or less. In our data, 88 percent of the firms with probationary periods had a probationary period of 3 months or less. This probably accounts for the fact that dismissal and layoff probabilities of unionized workers who have 3 or more months of tenure do not depend upon the worker's actual productivity. Dismissal decisions at large nonunion companies, seem to be more sensitive to a worker's productivity than the dismissal decisions at small non-union companies. Quit propensities react to company size in the opposite fashion. At companies with 200 or more employees, there is no tendency for the less productive employees to be more likely to quit. At small companies, there is such a tendency and it is statistically significant.

The primary prediction of human capital theory about job turnover is that workers who have a great deal of specific training should have lower rates of turnover. This proposition applies to workers who have completed their training or whose training is well underway. If the employer has paid for most of

the costs of specific training, a significant loss is suffered if a separation occurs, so we would expect the separations over which the employer has control (involuntary separations) to be negatively related to the amount of specific training. If the employee has paid for the specific training, one would expect voluntary separations but not involuntary separations to be negatively related to the amount of specific training provided.

Expected tenure is greater for workers who have received more than the normal amount of training. The elasticity of tenure with respect to training is apparently about 0.12. More intensive training raises expected tenure by lowering rates of involuntary termination. Holding productivity constant, a doubling of training investment during the first 3 months lowers the probability of being fired in the subsequent period by nearly 10 percentage points. Variations across workers in the amount of training received seem to have no effect on quit rates. The fact that additional investments in training reduce involuntary turnover but not voluntary turnover supports our previous finding that most of the training provided in the first months on a job is specific to the firm. Apparently some new hires are recruited for their potential not their experience. The receipt of extra training may reflect a belief in a worker's potential. For these workers low productivity during the first few months is not as negative as would be for someone with previous relevant experience, and very low rates of involuntary turnover result.

6. Training, Productivity and the Incidence of Promotions

About one-third of our sample of new hires were promoted before the date of our interview. Consequently, an analysis of promotions was conducted which paralleled the analysis of turnover. The results of this analysis of differences in promotion likelihoods of two recent new hires is presented in table 5. As one might anticipate, productivity during the 3d-12th weeks on the job was by far the single most important determinant of an individual's likelihood of promotion. Those who were 15 percent (0.10) more productive than other new hires in that job were 13 percentage points more likely to be promoted.

The coefficients on reported initial productivity are negative but not statistically significant. This implies that low productivity in the initial

weeks on a job is not held against a new employee being considered for promotion if learning is rapid and very high levels of productivity are attained. The size of the firm has no effect on how sensitive promotion decisions are to perceptions that a worker is highly productive. There does seem to be a tendency, however, for unionized firms to be considerably less affected by productivity when deciding about promotions than nonunion firms.

There is a clear tendency for those who receive more intensive training in the first 3 months on a job to have a higher probability of subsequently being awarded a promotion. A doubling of training intensity during the first 3 months is associated with a 7 percentage point higher probablility of promotion at companies with 19 employees. This association is even stronger at large establishments. If the company has 200 employees, a doubling of the training intensity in the first months is associated with a 31 percentage point higher probability of being promoted.

The finding that the most productive tend to be promoted and the least productive tend to quit or be fired has important implications for utility analyses of improvements in selection procedures. First the selective nature of exit from a job means that job incumbants with many years of tenure on a job should be more alike in their productivity than a sample of new hires. This means that estimates of the coefficient of variation of worker productivity that are based on samples of long term employees will typically be much smaller than those estimated from a sample of new hires.

Secondly, it implies that selective retention can and does to some degree substitute for careful initial selection. Since mistakes in initial selection tend to be corrected with time, the assumption that expected tenure is independent of the worker's productivity that is commonly made in utility analysis is clearly violated.

A third implication of these finding is that better selction procedures increases the expected tenure of the firm's work force and thus saves on hiring and training costs. The first and third of these influences raise the expected utility of improved selection by considerably more than the second tends to reduce it.

7.0 Implications

These findings have significant implications both for policy analysis and policy.

Implications for Policy Analysis and Research

While economic theory states that wage rates and earnings differentials are a good proxy for differentials in marginal productivity when different jobs and occupations are being compared, economic theory makes no such prediction when different individuals doing the same job are being compared. Consequently, the social return to an E&T achivement is the sum of its effect on the wage rate in large representative data sets and its effect on relative productivity given relative wage in samples of people doing the same job. The standard methodology for evaluating education and training programs does not involve this second step. Whenever, the actual learning and knowledge embodied in the graduates of an E&T program are hard to signal, the standard methodology will tend to underestimate the true social benefits of the program. When E&T program's reputation outdistances its performance, the conventional approach will overestimate social benefits. What the conventional approach evaluates is the reputation of a program's graduates not the true impact of the training on productivity. The biases that result are likely to be greatest when:

- A dimension of the E&T program other than graduation is being evaluated. The great difficulty of signaling the actual competencies developed means that the market will tend to underreward them.
- graduates are followed up for only a short period after program completion.
- The E&T program has not been in existence for a long time.
- The program is not highly visible to the employers who hire its graduates
- The E&T program does not provide employers with thorough documentation of the competencies of its graduates
- The trainees served by the program are from stigmatized groups such as welfare recipients or disadvantaged youth. The fact that a job applicant is a graduate of a CETA or WIN training program signals their membership in the stigmatized group as well as the fact of

their training. Employers who stigmatize these groups will be reluctant to hire the graduates of such programs. Stigmatization does not effect members of the control group, however, because members of these stigmatized groups do not volunteer their target group membership when they obtain jobs. The stigma attached to group membership thus affects trainees but not members of the control group.

Clearly, there is a need for more research on the extent and nature of these biases. Studies of relative productivity need to get high priority. When wage rates do not significantly vary in the sample such studies tell us the magnitude of the discrepancy between the social and private returns to that E&T achievement.

Implications for Education and Training Policies

The lack of information on achievements in school means that hiring selections and starting wage rates often do not reflect the competencies and abilities individuals developed in school. Instead, these decisions are based on observable characteristics such as educaitonal credentials that serve as crude signals for the competencies that cannot be directly observed. Spence (1973) and Stiglitz (1975) have shown that this may result in wage differentials that actually exaggerate the true value of the educational program and that this will result in overcertification--a tendency by the individual to overinvest in years of schooling.

Years in school is not, however, the only dimension of educational investment. The effort exerted per year is just as important. Consequently, an even more important implication of a signaling model is that whenever credentials are awarded for years in school and learning is difficult to verify by other means, the private rewards for effort and learning will be small and students will tend to underinvest in this dimension of their education. The same kind of problem arises in rewards for the quality and effort applied to on-the-job training.

The evidence presented has led the author to the conclusion that information externalities are distorting the rewards for certain types of learning and that the distortion is of significant magnitude. A demonstration of the existence of a discrepancy between wage differentials and productivity

differences across workers in a job does not, however, prove the existence of an information externality. Three of the six reasons for expecting relative wages to only weakly reflect relative productivity--compensation in the form of perks or relative status, deferred compensation, and low correlations of productivity over time--do not imply an information externality. The weak impacts of test scores on wage rates even for adults eliminates the deferred compensation and low correlations of productivity over time explanations of the discrepancy. But there remains the possibility that the observed discrepancies reflect a tendency to reward academic achievement in invisible ways such as praise, perks and higher status within the organization. If these rewards were large and anticipated by students when deciding about the effort to apply to their studies, there might be no tendency for students to underinvest in learning.

This might be part of the story but it cannot be the whole story. The reason for this conclusion is that relative productivity cannot be measured with perfect reliability and this will result in under compensation of real improvement in productivity even if the compensation comes in a form that is invisible to the analyst.

What would be the appropriate response of educational policy to the existence of information externalities of the type described above? The first response should be to generate better signals of the learning that occurs in school or on-the-job. If employers have access to information on the competency that job applicants have developed in school, they will make use of it.

The second response should be a restructuring of the system of rewards and recognition in the high school. Greater recognition needs to be accorded to academic achievement but even more important mechanisms must be found for recognizing the achievements of average and below average students so that everyone is provided incentives to try.

APPENDIX ON DATA AND MEASUREMENT ISSUES

This paper is based on data from a survey of 3,412 employers sponsored by the National Institute on Education (NIE) and the National Center for Research in Vocational Education (NCRVE) conducted between February and June 1982. The survey represented the second wave of a two-wave longitudinal survey of employers from selected geographic areas across the country.

The first wave was funded by the U.S. Department of Labor to collect data on area labor market effects of its Employment Opportunity Project (EOPP). The survey encompassed 10 EOPP pilot sites and 18 comparison sites selected for their similarity to the pilot site. The survey design specified a strategy of oversampling firms with a relatively high proportion of low-wage workers.

The second wave attempted to interview all of the respondents in the first-wave survey. About 70 percent of the original respondents completed surveys for the second wave. The data collected by this second survey on the training received by particular workers and their reported productivity are more extensive than those available in the first wave (or in any other data set known to the authors).

In the bulk of the sample, respondents were the owners/managers of the establishments. In large organizations, the primary respondent was the person in charge of hiring, generally the personnel officer. When primary respondents were unable to answer a question, they were asked if someone else in the organization would have the information, and that part of the interview was completed with this other official. Other respondents included comptrollers, wage and salary administrators, and line supervisors (for questions about a particular recent hire). Most of the respondents were the owner/manager of small firms who were quite similar with the performance of each of the firm's employees.

The paper analyzes data from a subsample of employers who gave information on two different recent hires for the same job. The 3,412 employers who received the full questionnaire were asked to select "the last new employee your company hired prior to August 1981 <u>regardless of whether</u> that person is still employed by your company." A total of 818 employers could not provide information for a recent new hire. Most of these firms were small organizations that had not hired anyone in recent memory. The employers that provided information

on one new hire were asked to provide data on a second new hire in the same job but with contrasting amounts of vocational education. Of the 2,594 employers that provided data on 1 new hire, 1,511 had not hired anyone else in that job in the last 2 years, and 424 had not hired anyone with a different amount of vocational training for that position in the last 2 years. As a result, data are available for 659 pairs of individuals who have the same job at the same establishment. Missing data on specific questions used in the model further reduced the sample used for estimation to about 480. Most of the establishments from which paired data are available are small. Seventy percent have fewer than 50 employees, and only 12 percent have more than 200 employees.1

Each employer surveyed was asked about the training provided to the two new employees, current and starting hourly wage rates and an average rate paid to workers with 2 years of experience, and the productivity of each new hire at various points in their tenure. A copy of the relevant portions of the questionnaire can be found in Exhibit 1 located at the end of the Appendix.

Data were obtained on the amount of time that is devoted to training new employees during their first 3 months. Separate questions were asked about training hours spent in formal training, informal training by management, informal training by co-workers, and watching other do the job.2 For the sample of firms and jobs, the means for the typical worker were as follows:

- Watching others do the job--47.3 hours
- Formal training programs--10.7 hours.
- Informal training by management--51.0 hours
- Informal training by co-workers--24.2 hours

A training time index was constructed that valued and then combined the time invested in training activities during the first 3 months on the job. The management staff member who provided formal and informal training were assumed to be paid 1.5 times the wage of a co-worker and the trainee's time was valued as equal to 0.8 hours of co-worker training time. When supervisors and co-workers are giving informal training to a new employee, the trainee is almost invariably involved directly in a production activity. Employers report that for informal training, the trainees are typically as productive while being trained as they are when working alone. Consequently, informal training is assumed to involve only the investment of the trainer's time. The training

time index is equal to 0.8 times the hours spent watching others do the job plus 1.8 times the hours in formal[3] training plus 1.5 times the hours in training by management plus hours in training by co-workers.[4] The arithmetic mean of this index is 124 hours, implying that the value of the time invested in training a typical new employee in the first 3 months is about 23 percent of the output that a co-worker would produce in 3 months.

The survey asked the employer (or in larger firms the immediate supervisor) to report on productivity of the typical individual hired in the job after 2 weeks, 12 weeks, and at the end of 2 years at the firm. The supervisor was asked to place a rating on a "scale of zero to 100 where 100 equals the maximum productivity rating any of your employees in (NAME's) position can obtain and zero is absolutely no productivity by your employee." The mean values of these indexes of reported productivity were as follows:

- First 2 weeks--49.0
- Next 10 weeks--64.6
- After 2 years--81.4

The interview questions about the productivity of recently hired employees were intended to provide indicators of the relative productivity of one worker at different points in time or two different workers in the identical job. They do not attempt to measure productivity in any absolute sense and therefore are not comparable across firms or across jobs in a firm. The question asking for a rating of the productivity of particular workers have remarkably low nonresponse rates. Only 4.4 percent of respondents asked about a particular new hire's productivity during the first 2 weeks responded with a "don't know" or refused to answer. Comparably defined nonresponse rates for other questions about the new hire were 8.2 percent for previous relevant experience, 3.2 percent for age, 6.7 for education, 8.6 percent for time spent in informal training by a supervisor, and 5.7 percent for a 3-question sequence from which starting wage rate is calculated. The low nonresponse rate implies that our respondents felt that they were capable of making such judgments and augurs well for the quality of the data that results.

In the paper, it is assumed that these productivity indexes are proportional transformations of true productivity plus a random error. If employer reports of a worker's productivity are equal to an unknown constant times the worker's true marginal product plus a random error, percentage differences in

cell means of the productivity index can be interpreted as unbiased estimators of percentage differences in true productivity. If the variations in the productivity scores assigned by supervisors exaggerate the proportionate variations in the true productivity, our estimates of percentage impacts of productivity on the wage or turnover will be biased downward. Errors in measurement will have the same effect. Even though it is possible for a worker's true productivity to be negative, the scale was defined as having a lower limit of zero. Floors and ceilings on a scale typically cause measurement errors to be negatively correlated with the true value. If this were the case, the result would be an understatement of percentage differences between the productivity of different categories of new hires and the measurement error bias would be mitigated somewhat. In our view, this latter type of bias is more likely than the former.

The fact that the employer is reporting on the past productivity of particular employees may generate biases in data. Some of these employees quit or were fired and some were promoted. These events might influence our respondent's memory of how productive the worker was initially and in the weeks preceding a separation. If this occurs, it would magnify the relationship between productivity and the wage rate and turnover outcomes. This would strengthen the paper's main conclusion that wage rates only partially reflect productivity differentials within the work group.

NOTES

1. Note that the sample is representative of on-the-job training provided by a group of employers, not the training activity associated with the employment of a group of job seekers during a specified time frame. The sample most likely underrepresents larger employers if the employment of a group of job seekers over a specified period of time were to be considered.

2. In a few cases, employers reported that more than 520 hours (13 weeks times 40 hours a week) had been devoted to a specific training activity during the first 3 months on the job. Although the new hire might have received training from more than one supervisor, it is unlikely that two trainers were simultaneously in one-on-one contact with the new hire. Consequently, the computer edit of this data changed all reports of more than 520 hours involved in a training activity to 520.

3. The cost of the trainer was assumed to be two-thirds of the foregone productivity, since formal training often involves more than one trainee. Thus $1.8 = (2/3)1.5 + .8$.

4. The index was constructed under an assumption that the four training activities were mutually exclusive. This implies that if the sum of the hours devoted to individual activities is greater than 520, that a reporting error has occurred which overstates investment in training. In the few cases where the sum of hours devoted to training exceeded 520, the training time index was adjusted downward by the ratio of 520 to the sum of the hours reported for individual activities. This procedure reduces the mean of the index by about 10 percent.

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